! TECHNICAL GUIDE #5 !

MEASURING NUTRITIONAL DIMENSIONS OF HOUSEHOLD FOOD SECURITY

Saul S. Morris

IFPRI **International Food Policy Research Institute**
2033 K Street, N.W.
Washington, D.C. 20006 U.S.A.

March, 1999

Contents

1. INTRODUCTION[1]

Improved nutrition is seen by many development agencies as a direct investment in human development that enhances the productivity of labor. This can be done both by strengthening the household resource base for food, and by enhancing target groups' control and management of these resources. Furthermore, through collaboration with various development agencies oriented towards nutrition-related health and education interventions, development projects and practitioners can play a critical catalytic role in overcoming the nutrition problems of the rural poor.

It is, however, the case that many practitioners will find that they do not have at their disposal all the information that they need to maximize the nutrition impact of rural development projects. This guide outlines methodologies that will assist practitioners to improve the nutrition impact of development activities. The methodologies described here are jointly referred to as *nutritional assessment*. The guide begins by explaining what is meant by nutritional assessment, and how it can reinforce linkages between nutrition and agricultural development. The guide then considers how nutritional assessment can be used in rural development projects for *beneficiary targeting* and *project formulation*, as well as for practical project *monitoring and evaluation*. It is concluded that nutritional assessment has great potential for geographical targeting at little additional cost, and is also a useful input into project formulation. It is invaluable at the monitoring and evaluation stage because it offers the possibility of directly measuring the human welfare impact of development activities, and also because the information generated can only with some difficulty be manipulated by interested parties. In the final section of the guide, the preceding theoretical discussions are illustrated using data from Honduras and Northern Ghana.

Project controllers and others interested in reading about these topics in more detail are advised to consult Gibson (1990) and World Health Organization (1995).

---

[1] Funding for data collection and analysis of these data has been supported by the International Fund for Agricultural Development (TA Grant No. 301-IFPRI). We gratefully acknowledge this funding, but stress that ideas and opinions presented here are our responsibility and should, in no way, be attributed to IFAD.

2. BACKGROUND: THE ROLE OF NUTRITIONAL ASSESSMENT IN MEETING THE CHALLENGE OF HUNGER AND POVERTY

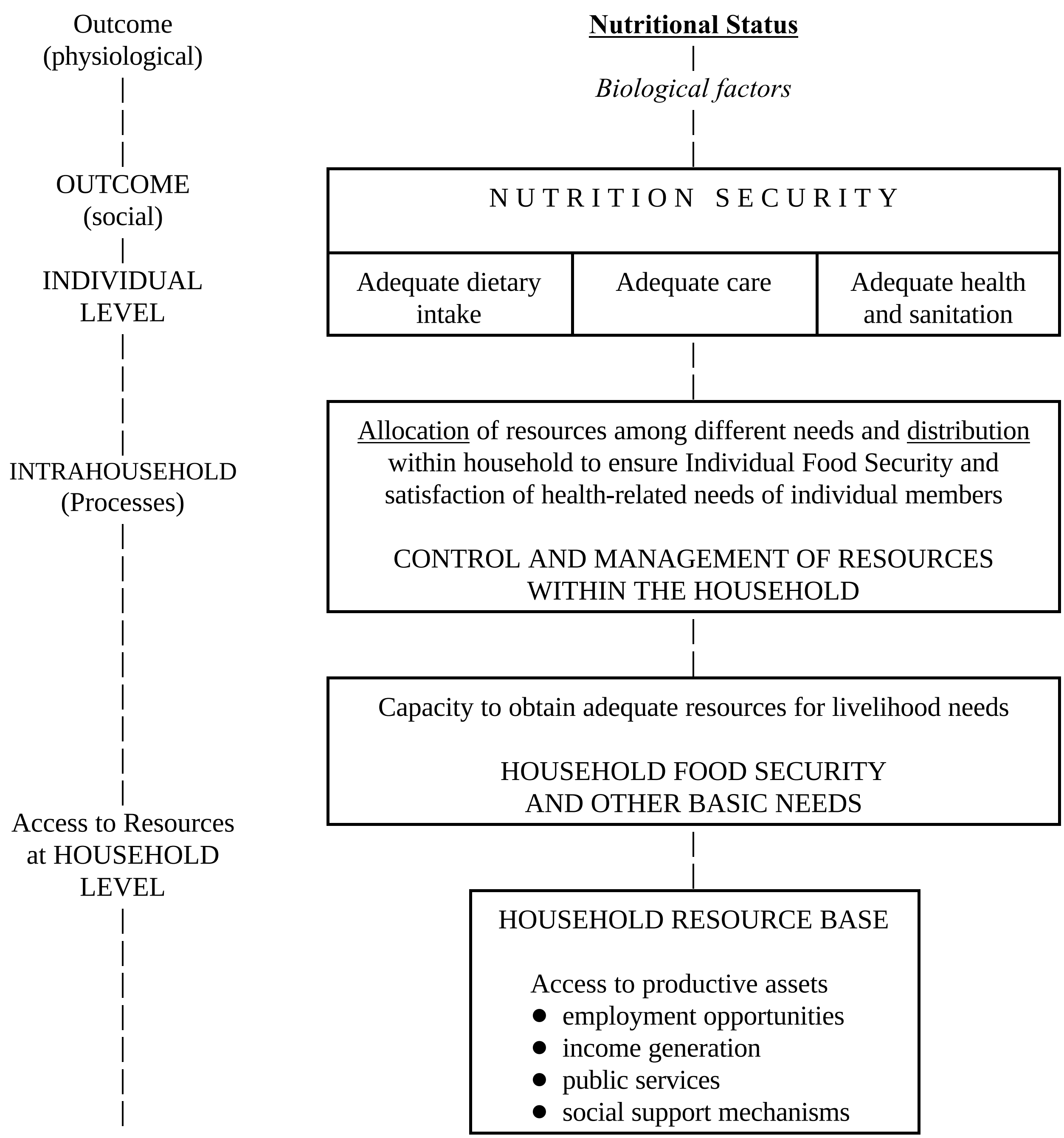
Nutritional assessments are measurements of body size, body composition, or body function, intended to diagnose single or multiple nutrient deficiencies. Sometimes nutritional assessments consist of highly controlled technical measurements, while in other circumstances, they may be conducted in a participatory manner, fostering the processes of community involvement and ownership of the project as a whole. Findings may be interpreted at the level of the individual, but are commonly aggregated over a community, district, or subnational region.

Previous development work (Frankenberger et al. 1993) has shown that such measures may be viewed as the biological manifestation of Nutrition Security, a "condition which combines having access to adequate food, being well cared for, and enjoying a healthy environment." The conceptual model developed by Frankenberger and colleagues is reproduced in Figure 1. In this model, rural development projects attempt to directly influence the household's resource base, and thus Household Food Security. It is clear that the link between Household Food Security and Nutrition Security is a complex one, making the naive use of nutritional measures by those seeking to draw inferences about food availability dangerous. On the other hand, it is unquestionably the case that all nutritional measures are sensitive to changes in dietary intake. Furthermore, the supposed weakness of these measures—their multicausality—is also their strength, since those agricultural projects working together with outside institutions to incorporate health and education components into their activities find themselves armed with a uniquely direct means of assessing the gains in human welfare arising from the synergistic effects of different interventions.

3. GETTING FAMILIAR WITH MEASURES OF NUTRITIONAL STATUS

There are numerous different measures of nutritional status, varying with respect to their ease of measurement, relation to dietary intake, and velocity of change following shocks or improvements in the individual's environment. Three major classes of measures may be distinguished. The first class uses *clinical examinations* to detect signs and symptoms of

Figure 1 Nutrition security



Source: Frankenberger et al. 1993.

advanced nutritional depletion. Examples are surveys of goitre to detect iodine deficiency, or eye examinations to detect vitamin A deficiency. With appropriate training, lay enquirers can be used to determine levels of these conditions in the community. In contrast, *laboratory methods* are usually invasive (involve taking samples from sites of the body that are not immediately accessible) and therefore poorly suited to routine use in a program situation. These methods are used to detect decreased levels of nutrients in body tissues or fluids, or decreased activity of an enzyme that is nutrient-dependent. One example of a 'laboratory' method with potential for more general use is the detection of anemia by hemoglobinometry (see below).

The third class of measurements, which we will focus on in this document, is *anthropometry*, the measurement of body size and gross body composition. The basic principle of anthropometry is that prolonged or severe nutrient depletion eventually leads to retardation of linear (skeletal) growth in children, and to loss of, or failure to accumulate, muscle mass and fat in both children and adults. These problems can be detected by measuring body dimensions, such as standing height or upper-arm circumference, or total body mass (weight). All of these measures are expected to vary by the age of the person measured and by their sex, so that there is a need for the measurements to be *standardized* for age and sex before they can be interpreted.[1] Easy-to-use computer applications are available to perform this transformation.

The five most commonly used anthropometric indices are described in more detail in Table 1. It will be noted that there is a strong emphasis on children under five years of age, because children are especially vulnerable to adverse environments and respond rapidly to changes. In particular, when children do not receive the nutrients they need, their growth is rapidly compromised, with long-term implications for their future productivity. On the other hand, although adults also lose weight in response to severe energy deficit, this effect can be very difficult to distinguish from their genetic potential. The selection of appropriate measures for different programmatic purposes is described in later sections of this guide.

Anthropometric measurements are subject to a number of sources of error, including instrument error, investigator error, and recall error (for measures based on age). These sources of error need to be controlled, since they can easily lead to overestimates of the frequency of malnutrition, or underestimates of the effectiveness of interventions. Special standardization procedures have been developed to minimize measurement error (Habicht 1974).

Table 1   Commonly used anthropometric indices

Indicator	Age group	Requirements
Height-for-age/Length-for-age 'Height' measured as recumbent length for under 2-year-olds. Measure referred to standard for well-nourished individual of same age and sex (usually National Center for Health Statistics [NCHS]).	up to puberty	Extensive training required for measurement of recumbent length of infants and young children. Accurate age information required (often misreported in nonliterate societies).
Weight-for-age Measure referred to standard for well-nourished individual of same age and sex (usually National Center for Health Statistics [NCHS]).	up to puberty	Accurate age information required (often misreported in nonliterate societies).
Weight-for-height/Weight-for-Length Weight measure referred to standard for well-nourished individual of same height and sex (usually National Center for Health Statistics [NCHS]). 'Height' measured as recumbent length for under 2-year-olds.	infancy and childhood	Extensive training required for measurement of recumbent length of infants and young children. Two different body measurements required.
Mid-upper arm circumference Special insertion tape used to identify mid-point of upper arm and measure circumference at this point.	all ages	Relatively little training required.
Body mass index Weight (kilograms) divided by height (meters) squared.	adult	Two different body measurements required.

4. USING NUTRITIONAL ASSESSMENT TO IMPROVE THE IMPACT OF RURAL DEVELOPMENT PROJECTS

In the following sections, we show how nutritional assessment methods may be used to improve project formulation, beneficiary targeting, monitoring, and evaluation. Many of the approaches proposed take advantage of the increase in the availability of nutritional data that has occurred since 1990 (see Technical Guide #2). Other approaches require collection of new data, and interested readers are strongly advised to consult Technical Guide #8 before undertaking data collection activities.

Country Strategy, Project Inception, and Formulation

Extant data on nutritional status may be especially valuable at the country strategy and project inception stages, both for targeting subnational regions and for needs assessment.

Where nutrition security is a priority, the identification of areas of the country most at need of rural development interventions is facilitated by reference to existing sources of nutrition data. The principal nutritional indicator for **targeting subnational regions** is

> **proportion (absolute numbers) of children under 5, or of school age (6-10 years), with low height-for-age (stunted)**. This indicator, more than any other, is recommended for identifying areas of greatest need for targeting economic and health interventions (WHO Expert Committee on Nutrition 1995). Weight-based measures are, in general, too sensitive to illness and specific child-care practices, and are subject to seasonal variations. Data on stunting are available at the subnational level for virtually all poor countries, from surveys (such as the Demographic and Health Surveys) and/or from school height censuses. The usefulness of the measure for project targeting can be enhanced by expressing the numbers on a per kilometer squared basis.

Regions/communities with large numbers of children characterized by low height-for-age are found in each of Asia, Africa, and Latin America and the Caribbean, though the condition is most common in South Asia (UN ACC/SCN 1998). In Latin America and the Caribbean, the prevalence of low weight-for-age (underweight) can be used as a proxy measure for low height-for-age (stunting), since the two indicators are highly correlated in this region where low weight-for-height (wasting) is not seen.

Another measure that may be of use in contexts of extreme poverty is

> **proportion (absolute numbers) of adults and adolescents with low body mass index**. This indicator identifies areas of severe food insecurity. Data are sometimes available at the subnational level from surveys (such as the Demographic and Health Surveys, which commonly assess the nutritional status of women of reproductive age). The usefulness of the measure for project targeting can be enhanced by expressing the numbers on a per kilometer squared basis. Caution should be exercised when using this measure in areas where advanced HIV disease is prevalent, since individuals with HIV disease are thin, but not as a result of food insecurity.

Regions/communities with large numbers of adults/adolescents characterized by low body mass index are found in Asia and Africa. Small mid-upper arm circumference is sometimes used as a proxy measure for low body mass. It should be noted that the presence of significant numbers of adults (say, ≥ 10 percent) with very low body mass index normally indicates a need for emergency relief, rather than rehabilitation or development.

Needs Assessment

Also at the project formulation stage, nutritional measures can be reviewed to assess the needs of project beneficiaries. Normally this process is carried out for the project area as a whole, but where possible, it is informative to disaggregate by variables known a priori to be linked to nutrition security, such as land ownership, gender of household head, sanitary/health care resources, etc. Nutrition indicators for needs assessment are described in Table 2.

The needs assessment process should start by collating nutritional data from as many different *population-based* sources as possible (data collected at health centers or from currently operating selective programs are much more difficult to interpret, due to the inevitable biases).[2] The information should be arranged by indicator, age group studied, and year of collection. Conflicting evidence from different sources should be carefully reviewed with the help of local experts to identify the source of the discrepancy. Subsequently, it may be helpful to rank the different problems identified according to their frequency in the population.

It is useful to compare the same indicator across different age/sex groups. For example, stunting in children where adults are also short may be more suggestive of intergenerational deprivation effects than of current food access or health problems; similarly, while wasting in children may indicate poor feeding practices or health problems, the combination of wasting in children and low body mass in adults indicates a crisis in entitlements to food. Specific nutrient deficiencies (e.g., iron or vitamin A) are not uncommon in children due to poor feeding practices; however, when they are also found in adults, a problem of food access should be suspected.

It is also important to contrast different indicators: substantial childhood wasting in the absence of stunting, for example, indicates a nutritional crisis of very recent advent; stunting in the absence of wasting, on the other hand, indicates a complex and deep-rooted nutritional problem, sometimes not directly related to food availability at the household level. Similarly,

Table 2   Nutritional indicators for needs assessment exercises

Indicator	Interpretation
Prevalence of low **height-for-age (stunting)** in preschool or school-age children	Children's skeletal (*linear*) growth compromised due to constraints to one or more of nutrition, health, or mother-infant interactions. In some populations, these constraints are already apparent in utero. Quality of diet a more frequent limitation than inadequate quantity.
Prevalence of low **weight-for-height (wasting)** in preschool or school-age children	Children suffer *thinness* resulting from energy deficit and/or disease-induced poor appetite, malabsorption, or loss of nutrients. Energy deficit may be due to lack of food in household or feeding of low energy density foods that satiate before the child meets its energy requirements.
Prevalence of low **weight-for-age (underweight)** in preschool or school-age children	This indicator confuses the two processes described above and is therefore not a good indicator for needs assessment purposes.
Prevalence of low **body mass index** in adults or adolescents	Adults suffer *thinness* as a result of inadequate energy intake, an uncompensated increase in physical activity, or (severe) illness.
Prevalence of low **mid-upper arm circumference** in adults/adolescents	As above. Restricting analysis to the arm has the advantage of reflecting the mass of just three tissues—bone, muscle, and fat—the last two of which are particularly sensitive to body weight gain/loss.
Prevalence of low **serum retinol** in preschool children.	Children suffer vitamin A deficiency, either as a result of low intake of vitamin A in the diet, or because there is a high frequency of infection, leading to sequestering of vitamin A from the blood.
Prevalence of **low hemoglobin (anemia)** in preschool or school-age children	Children suffer from anemia, either as a result of low iron intakes or poor absorption, or as a result of illness. Severe protein-energy malnutrition and vitamin B12/folate deficiency can also lead to anemia.
Prevalence of **low hemoglobin (anemia)** in nonlactating, nonpregnant women	Women suffer from anemia as a result of low iron intakes, poor absorption, illness, or excessive losses of blood. Severe protein-energy malnutrition and vitamin B12/folate deficiency can also lead to anemia.
Prevalence of **low hemoglobin (anemia)** in men	As above. Anemia is rare in adult men except in conditions of extreme iron deficient diets.

specific nutrient deficiencies in the absence of stunting or wasting may indicate either poor feeding practices or a general problem of dietary quality, while combined with stunting and/or wasting, they are more likely to indicate profound poverty of resources at many levels.

Project Implementation

Just as nutrition data can assist with targeting and needs assessment at the project formulation stage, so they can also be of assistance for small-area targeting and sequencing of interventions in the implementation phase.

The potential of **small-area targeting** has been discussed elsewhere (Technical Guide #9). This procedure is greatly facilitated when nutritional data are available at a fine level of disaggregation, permitting the identification of priority-need small areas (usually districts or municipalities) within the overall area of influence of the project. School height censuses are an obvious source of such data, but detailed nutritional surveys are also occasionally available. Where such data are available, their use and interpretation are exactly as described in the previous section (see above). Where these data are not available, conducting a large-scale nutritional survey for the purpose of small-area targeting is likely to be very cost-ineffective; other indicators should therefore be used (see Technical Guide #7).

Only in exceptional circumstances are nutritional data available at a level of disaggregation sufficiently fine to permit **community-level targeting**. Often, however, socioeconomic data can be collected that permit the estimation of the expected rate of malnutrition in the community (see Technical Guide #3).

For a number of reasons, it is unwise to use nutritional measures for **household-level targeting** in rural development projects. These reasons include the following:

- Many of the measures that have been discussed in the previous sections are dependent on the presence of a household member of a particular age and/or sex, and thus exclude a priori households of a different composition.
- Most nutritional measures are age-sensitive, so that a two-year-old child is much more likely to be stunted than a one-year-old, even though the conditions of the household are identical.

- Some measures of nutritional status change in a relatively short time, so that a child who has just been ill can easily be wasted even where the household's conditions are generally good.
- Many other measures reflect past conditions, or even inter-generational effects, more strongly than current conditions.
- The cut-offs used to determine the presence or absence of malnutrition are arbitrary, so that a child with a height-for-age Z-score of -2.1 is classified as stunted while one with a Z-score of -2.0 is not, even though there is little reason to include the first family in a development program and not the second.
- Finally, there have been instances where families in areas with projects using individual targeting-based nutritional status have actually withheld food from children so that their nutritional status will deteriorate and the family will be entitled to participate in the project.

The nutritional needs assessment described above is expected to identify the broad features of an appropriate nutrition strategy for the project area. Beyond this, the search for interventions should be guided by an analysis of the constraints to nutrition security in *each* of its contributing areas: household food security, health, and mother-infant interaction. As nutritional indicators represent the joint outcome of all of these factors, there is only a limited amount of information that they can provide on the *causes of*, and *solutions to*, nutrition insecurity.

Monitoring and Evaluation

Nutritional assessment can be an extremely valuable element of the monitoring and evaluation process in rural development projects for a number of different reasons:

- Nutritional measurements provide a measure of human welfare that is sensitive to changes in food supply, as well as to other community development processes.
- Nutritional measurements provide a nonsubjective, quantitative assessment of progress towards a fixed goal (the elimination of malnutrition).

- Nutritional measurements cannot easily be falsified by individuals with vested interests in the outcome of the interventions (including the subjects themselves).
- Nutritional measurements are relatively easy to obtain, either in sentinel sites for the purpose of ongoing monitoring, or in a sample of the entire study area for the purpose of evaluation.

In order to assess whether project interventions have improved nutrition security among beneficiaries, it is first necessary to identify which nutritional indicators could plausibly have been altered by project interventions, and which subgroups of the population are most likely to have benefitted. For example, a project that has as its sole aim the promotion of home gardening should not be expected to produce an impact on adult BMI, since vegetables are, in general, rich in micronutrients but not in energy.[3] Similarly, a project aimed at increasing basic grain production in rural Africa is unlikely to affect the nutritional status of infants less than six months of age, since these infants usually consume only breast milk and are therefore unaffected by changes in the family diet. Relevant nutritional indicators for assessing the impact of a variety of different interventions are shown in Table 3.

The length of time that an intervention has been in place is also an important variable to take into account when selecting nutrition indicators and study populations, since different indicators reflect events in the recent and distant past with different intensities, and take different amounts of time to respond to such changes (Table 4).

There any many different ways of using nutritional assessment to determine whether project interventions are improving, or have improved, the nutrition security of the beneficiary population. In the following sections, we examine four such methods, namely, the use of sentinel sites for the monitoring of nutritional impact, the examination of changes in nutritional status of populations before and after implementation of project activities, the analysis of changes in the nutritional status of *individuals* before and after implementation of project activities, and the comparison of achieved nutritional status across beneficiary and nonbeneficiary populations.

Table 3 Nutrition indicators for monitoring and impact assessment

Intervention	Most relevant nutritional indicators
Improved availability of food (dietary energy) at the household level, *in areas where dietary energy intake is initially constrained*	BMI (adults) Weight-for-height Z-score (2-5 year olds) Weight-for-age Z-score (2-5 year olds) Height-for-age Z-score (long-term evaluations only; 2-5 year olds)
Improved availability of food at the individual level, plus improvements in other basic needs, especially health	Height-for-age Z-score (under 5s) Weight-for-age Z-score (under 5s) Weight-for-height Z-score (under 5s)
Increased intake of animal products	Anemia (Hemoglobin) Serum Vitamin A (retinol)
Increased intake of fruits and leaves	Serum Vitamin A (retinol)

Sentinel Sites for Monitoring Nutritional Status

Sentinel sites (a few purposively selected 'representative' locations where data collection and analysis activities are concentrated) have frequently played a major role in project monitoring activities. For project management, the advantage of setting up a sentinel site system is that a relatively small number of people can be intensively trained to provide needed information in a timely and systematized manner. On the other hand, there is always the danger that the sentinel sites selected may not be representative of the project area as a whole, and that

Table 4 Time reference of different nutritional indicators

Indicator	Time reference for dietary influences
Serum Vitamin A	Essentially, consumption over recent days. Can be influenced by consumption events up to 4 months in past.
Hemoglobin	Consumption over recent weeks and months.
Weight-for-height, BMI	Consumption over recent weeks.
Height-for-age	Cumulative life-time consumption, especially influenced by events occurring in first two year of life and prenatally.
Weight-for-age	Mixture of weight-for-height and height-for-age effects.

the data collected may become more or less reliable over time as those charged with the data collection master the techniques, or, alternatively, lose interest in the monitoring process.[4]

The most important element of a successful monitoring system is a mechanism for ensuring that the data are promptly collated and analyzed so that they can feed into decisionmaking processes without delay. Nutritional indicators should be selected on the basis of the simplicity of measurement: weight-for-age would be the indicator of choice in many communities, although mid-upper arm circumference may be as good or better in communities where acute or seasonal food shortages are known to occur and to result in fluctuations in body mass. The analysis of the data should focus on obtaining moving averages[5] that reflect important changes in nutritional status without being excessively dominated by short-term 'blips'. It is likely to be necessary to control for the effect of the aging of the study cohort over time, as this leads to apparent improvements in nutritional status that are—sadly—illusory. Samples of approximately 100 individuals are likely to be sufficient for the monitoring of trends over time, with measurements perhaps every two or three months. Ongoing monitoring may be linked to the evaluation strategies described in the following sections, but it is important to realize that it does not, in and of itself, provide evidence of any *impact* of project activities. Rather, it indicates that within the intervention area, changes are or are not occurring in the direction expected, and are or are not of the desired magnitude (see Technical Guide #10).

Evaluating Changes in Nutritional Status of Populations before and after Implementation of Project Activities

One popular way of determining the impact of project activities on nutrition security is to conduct one survey prior to implementation and another at the end of the evaluation period, examining changes in the nutritional profile of the population over the two points in time. This type of evaluation is credible if it can be demonstrated that the population surveyed is the same at each period in time (e.g., a representative sample of all adult women in the project zone of influence). It is not necessary for the *individuals* in the survey to be the same; indeed, often it is unavoidable that the individuals are different, such as when the nutritional status of children under five is measured before and after a five-year development project. The comparison may be strongly influenced by factors specific to the timing of the two surveys. This is particularly the case when nutritional measures are used that are sensitive to short- or medium-term fluctuations in intake (e.g., serum vitamin A). It is less of a problem when using measures such as height-for-age Z-scores, which reflect cumulative influences over a substantial period of time.

When the beneficiary population alone is studied, the evaluation can determine whether the observed changes in nutritional status are of the expected direction and magnitude, but is unable to causally link program activities to observed changes. When a "control" group is also measured at the same time points as the intervention group (see Technical Guide #10), it is possible to infer whether changes in nutritional status appear to be more beneficial in the intervention group than in the control group. The before-after comparison is usually expressed as the change in mean values of the nutritional indicator, but can also be expressed as the relative (or absolute) change in the proportion of the population with values below some critical measure. The latter comparison may be more relevant from a human welfare perspective, but requires larger sample sizes than the comparison of means approach.

One factor specific to studies with nutritional status as outcomes is that the interpretation of the results will be strongly influenced by the age composition of the study population. If the age composition has changed between initial and final surveys, or if the intervention group has a different age structure to the control group, be it ever so slight, this MUST be taken into account in the analysis. Since adjusting for age effects requires some knowledge of statistical methods, the utmost care should be taken to ensure comparability of the initial and final samples.

Analysis of Changes in Nutritional Status of Individuals before and after Implementation of Project Activities

In some situations, it is possible to track individuals over time and to examine associations between project activities and *changes* in nutritional status at the individual level. This approach to measuring project impact is expected to be far more sensitive than the approach outlined above.[6] An individual's final height minus initial height is referred to as *gain in height*, while their final weight minus initial weight is referred to as *weight gain*. Since the amount of gain in height and/or weight is dependent on the time elapsed between the two measures, it may be appropriate to express these measures as *gain per unit time*, usually referred to as height or weight *velocity*. It is very important to realize that height and weight velocity are both sex- (and especially) age-dependent, so that analysis must take account of different age structures of intervention and control groups. One other complication that should also be borne in mind is that many individuals will not be able to be traced at the time of the second survey. Since these individuals are always different from those who remain traceable, the picture of project impact obtained may be unrepresentative.

It is not a good idea to calculate an individual's change in Z-score from one time period to another, since, for example, a half Z-score deterioration in nutritional status in an infant can have very different physiological implications from a half Z-score deterioration in an older child. Such comparisons are also confounded by technical problems with the NCHS reference.

Comparison of Achieved Nutritional Status across Beneficiary and Nonbeneficiary Communities

In the absence of data on nutritional status prior to intervention, it is possible to directly compare the attained nutritional status of children of project beneficiaries with the attained nutritional status of children of nonbeneficiaries. In order to be able to interpret the results of such a comparison, it is necessary either to assume that beneficiaries and nonbeneficiaries were comparable prior to the project intervention, or else to adjust statistically for variables known to affect beneficiary status. The many dangers inherent to both approaches are explained in detail in Technical Guide #10.

If all concerns about using these methods are satisfied, beneficiaries may be compared to nonbeneficiaries either with respect to average (mean) nutritional status, or with respect to the proportions falling below a critical cut-off point. If this method is used, it is particularly important to select an indicator that can reasonably be expected to be sensitive to dietary intake and changes in the household environment *over the period of evaluation*. Some degree of internal control may be obtained by comparing the experience of a subgroup of the population who can be expected to have been responsive to the project interventions to that of a subgroup who would not be expected to have responded to the particular kind of interventions implemented, or within the time frame under consideration.

5. CASE STUDY OF THE AGRICULTURAL DEVELOPMENT PROGRAM FOR THE WESTERN REGION (PLANDERO), HONDURAS[7]

Project Placement

Figure 2 shows the prevalence of severe stunting (height-for-age below -3 standard deviations of the NCHS median) in the 18 *departamentos* of Honduras.[8] The data are taken from the Sixth Census of First-Graders' Heights (Republic of Honduras, Secretary for Education 1996). The prevalence of stunting exceeds 21 percent in four *departamentos* of the West (South-West) of Honduras: Copán, Lempira, Intibucá, and La Paz. The PLANDERO project covers Copán and Lempira, but also Ocotepeque, where the prevalence of stunting is half that of Intibucá.

Figure 3 shows the number of stunted first graders per 100 hectares of land area. Lempira, Intibucá, and La Paz have the highest densities of malnourished children in the country, followed by Francisco Morazán and Cortés, areas where the very high population densities, rather than high prevalences of malnutrition, result in high concentrations of malnourished children. Copán is the sixth of 18 *departamento*s when ranked by density of malnourished children, and Ocotepeque is the eleventh of 18. Table 5 shows the correspondence between the rankings based on the prevalence of malnutrition, and those based on the density per unit land area.

In conclusion, it appears that the location of the PLANDERO project is generally appropriate for a project aiming to impact on nutrition security in Honduras, although it could be argued that it would have been preferable to exclude the *departamento* of Ocotepeque from the project's zone of influence.

Needs Assessment

Nutritional parameters for the project area are given in Table 6. The information has been collated from three different surveys and censuses conducted in recent years. Childhood stunting is the major nutritional problem in the area: the levels recorded, around 60 percent of all children, are among the highest in the world. There is virtually no wasting in this population, so that the relatively high levels of underweight can be attributed entirely to stunting. Similarly, there is very little chronic energy deficiency in adults: although 8 percent of mothers of young children

Figure 2 Percentage of first graders severely stunted (height-for-age Z-score <-3), Honduras, 1996

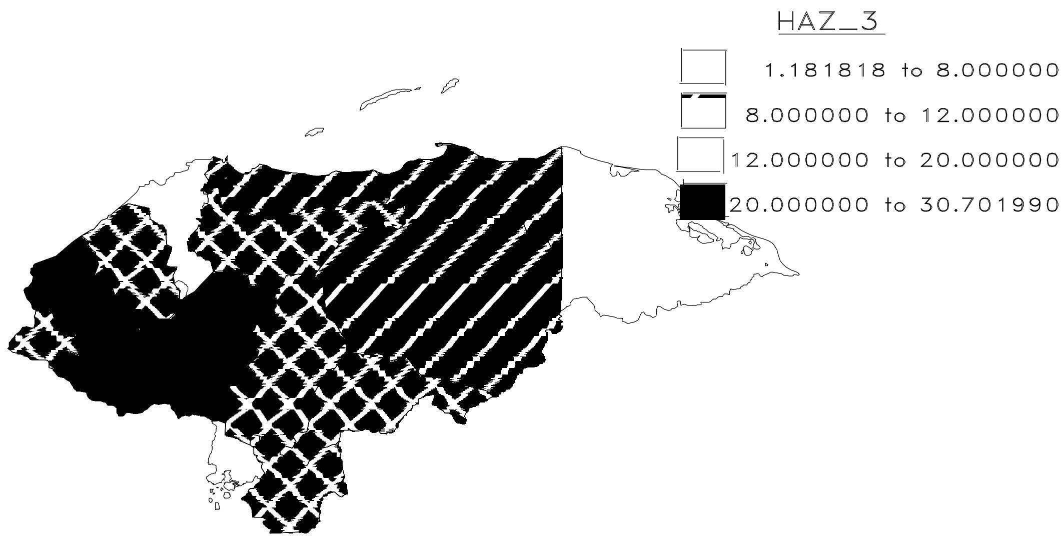


Figure 3 Density of severely stunted first graders per 100 hectares, Honduras, 1996

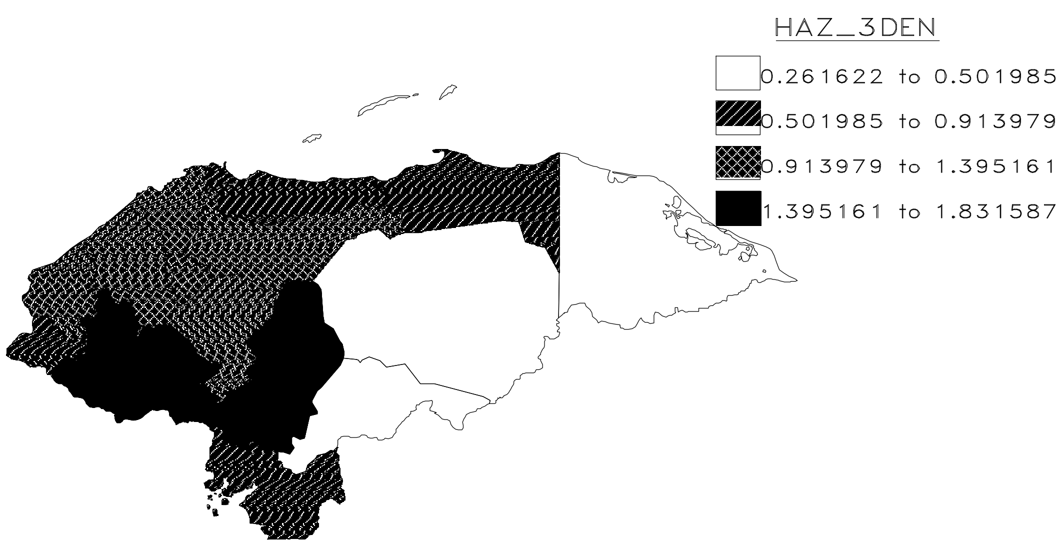


Table 5 Numbers of severely stunted first graders per 100 hectares, and proportions of first graders severely stunted in the 18 *Departamentos* of Honduras

Departamento	Severely stunted first graders per 100 hectares	Proportion of first graders severely stunted	
		(percent)	(*rank*)
Intibucá	1.83	30.70	*1*
Lempira	1.79	27.22	*2*
La Paz	1.56	21.11	*4*
Francisco Morazán	1.40	8.24	*14*
Cortés	1.32	7.95	*15*
Copán	1.23	21.27	*3*
Comayagua	1.05	13.77	*7*
Santa Barbara	.92	17.95	*5*
Yoro	.91	12.26	*9*
Valle	.84	7.79	*16*
Ocotepeque	.73	14.52	*6*
Atlantida	.67	8.51	*12*
Choluteca	.58	9.88	*10*
Colon	.50	8.46	*13*
El Paraiso	.45	12.80	*8*
Gracias A Dios	.34	4.49	*17*
Olancho	.29	9.52	*11*
Islas de La Bahia	.26	1.18	*18*

Table 6 Nutritional indicators, Western Honduras

Indicator	Age group	Value (percent)	Geographical area	**Reference**
Severe stunting (HAZ < -3)	First graders	22.6	Copán, Lempira & Ocotepeque	Sixth Census of Height of First Graders, 1996
Stunting (HAZ < -2)	First graders	56.4	Copán, Lempira & Ocotepeque	Sixth Census of Height of First Graders, 1996
Stunting (HAZ < -2)	Children < 5 years	60.0	Rural areas of Ocotepeque, La Paz, Lempira and Intibucá	NHCIENS94
Underweight (WAZ < -2)	Children < 5 years	32.8	Rural areas of Ocotepeque, La Paz, Lempira and Intibucá	NHCIENS94
Wasting (WHZ < -2)	Children < 5 years	3.5	Rural areas of Ocotepeque, La Paz, Lempira and Intibucá	NHCIENS94
Severe stunting (HAZ <-3)	Children 12-71 months	30.3	Rural areas of Ocotepeque, La Paz, Lempira and Intibucá	Encuesta Nacional sobre Micronutrientes, 1996
Stunting (HAZ <-2)	Children 12-71 months	62.7	Rural areas of Ocotepeque, La Paz, Lempira and Intibucá	Encuesta Nacional sobre Micronutrientes, 1996
Underweight (WAZ <-2)	Children 12-71 months	37.6	Rural areas of Ocotepeque, La Paz, Lempira and Intibucá	Encuesta Nacional sobre Micronutrientes, 1996
Wasting (WHZ <-2)	Children 12-71 months	1.5	Rural areas of Ocotepeque, La Paz, Lempira and Intibucá	Encuesta Nacional sobre Micronutrientes, 1996
Low body mass index (< 18.5)	Mothers of Children 12-71 months	8.3	Rural areas of Ocotepeque, La Paz, Lempira and Intibucá	Encuesta Nacional sobre Micronutrientes, 1996
Low serum retinol (< 20 µg/dl)	Children 12-71 months	18.7	Rural areas of Ocotepeque, La Paz, Lempira and Intibucá	Encuesta Nacional sobre Micronutrientes, 1996
Anemia (Hb < 11 g/dl)	Children 12-71 months	29.7	Rural areas of Ocotepeque, La Paz, Lempira and Intibucá	Encuesta Nacional sobre Micronutrientes, 1996
Anemia (Hb < 11 g/dl)	Mothers of children 12-71 months	26.7 percent	Rural areas of Ocotepeque, La Paz, Lempira and Intibucá	Encuesta Nacional sobre Micronutrientes, 1996

had body mass indexes below 18.5, virtually none had values below 17 (severe energy deficiency).

These sources reveal that in the area of influence of PLANDERO, the proportion of preschool children stunted rises from 33 percent in the highest (national) income quartile to 62 percent in the lowest quartile, and from 39 percent in households with high caloric adequacies to 67 percent in those with the lowest. The fact that stunting does not fall to low levels, even among those who are relatively well-off, may be attributed to (1) environmental features (e.g., illness), which no one living in the region is protected from, and (2) intergenerational effects, reflecting the low stature of the children's mothers (with an average height of only 148 centimeters) and growth retardation in utero.

With respect to specific nutritional deficiencies, vitamin A deficiency (as measured by low serum retinol) constitutes a public health problem of 'moderate' importance, according to international guidelines (WHO/UNICEF 1994). It is been shown (Encuesta Nacional de Micronutrientes 1996) to be strongly associated with raised acute phase proteins (indicating infection), suggesting that it may result more from illness than from a lack of vitamin A in the diet per se. Anemia, on the other hand, is more common, both in children and in their mothers. There is also a strong association between anemia and infection, but the direction of causality cannot be determined.

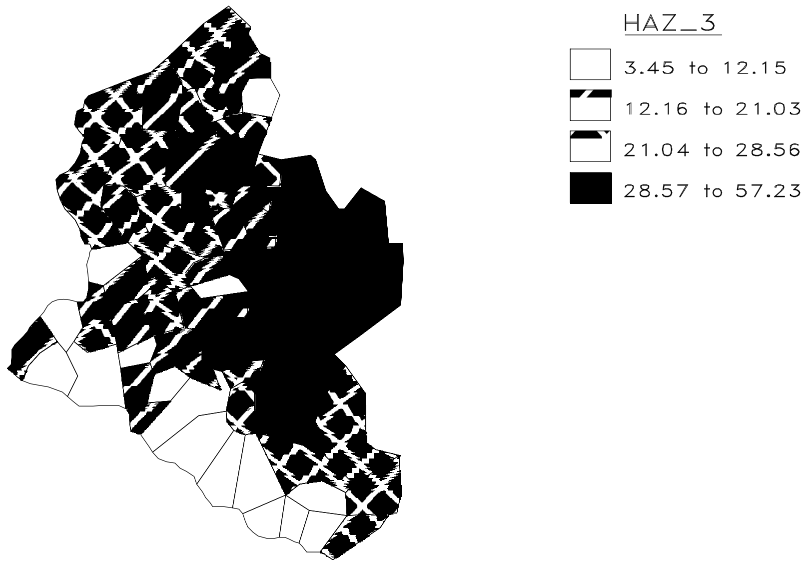
These features suggest a population where ill health, poor caregiving practices, and perhaps dietary quality are likely to be major constraints to nutrition security, but an absolute deficit of dietary energy is not likely to be common. In these circumstances, increasing agricultural productivity alone cannot produce marked changes in nutrition security, even in the very long term. In order to impact on nutrition security, PLANDERO might therefore choose to work in close coordination with health- and education-sector collaborators, and invest in breaking down the isolation and poverty of the region in the longer term.

Targeting at the *Municipio* Level

Figure 4 shows the prevalence of severe stunting (height-for-age below -3 standard deviations of the NCHS median) in the 66 *municipios* of Western Honduras. The data are taken from the Sixth Census of First-Graders' Heights (Republic of Honduras, Secretary for Education 1996). The prevalence of severe stunting exceeds 30 percent in 13 *municipios* of the Center, North-East and North-West of Lempira, and the Center-East of Copán, and is below 10 percent in 9 *municipios* of Ocotepeque, Southern Lempira, and the far South of Copán.

In order to assess the ability of PLANDERO to target its activities to the areas with the worst nutritional problems, each beneficiary family was given a score based on its *municipio* of residence: families living in *municipios* with the highest levels of stunting were given the highest

Figure 4 Percentage of first graders stunted, Western Region, 1996



scores, while those living in the *municipios* with the lowest levels of stunting were given the lowest scores.[9]

The distribution of severely stunted first graders and of the project's beneficiary families in the first three project years (estimated numbers for 1988) is shown in Figure 5. The average stunting and severe stunting scores for beneficiary families in 1996, 1997, and 1998 (estimated) are shown in Table 7. The project was geographically neutral in its targeting in the first and second years of enrollment. In the third year (1998), *new* project beneficiaries were somewhat more likely to live in areas with more severe nutritional problems, so that the average scores of the new households were 63.5 (stunting) and 27.5 (severe stunting). However, the number of new beneficiary households anticipated in 1998 was small relative to the number already included in the project (30 percent of 1996 numbers), with the result that the overall targeting of project activities remained essentially neutral.

Monitoring

Figure 6 shows the proportion of first graders stunted for each year from 1994-97 in two almost adjacent *municipios* in Western Honduras. In the *municipio* of La Labor, which had a

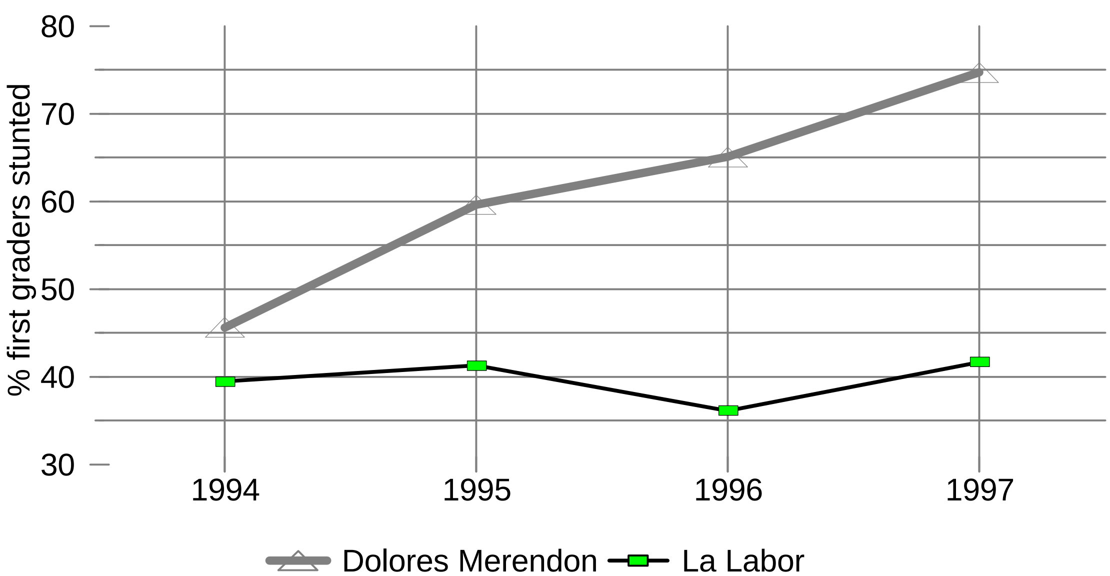
Figure 5 Distribution of PLANDERO beneficiary households and malnourished first graders, Western Honduras, 1996-98 (1 dot = 2 households/first graders)

Table 7 Frequency of (severe) stunting among first graders, and (severe) stunting 'score' of beneficiary households, Western Honduras

	n	Stunting score	Severe stunting score
Western Honduras, 1996	all first graders (23 129)	56.4	22.6
PLANDERO, 1996	1 632	56.2	22.8
PLANDERO, 1997	3 930	56.3	22.1
PLANDERO, 1998 E	5 109	57.9	23.4

relatively strong institutional presence in 1993 (17 percent of farmers receiving technical assistance and 25 percent receiving credit) and was one of the first *municipios* to have groups assisted by PLANDERO in 1996, the rate of stunting remained almost unchanged throughout the period at approximately 40 percent. On the other hand, in Dolores Merendón, which had very limited institutional presence in 1993 (7 percent coverage of technical assistance and 6 percent of farmers receiving credit) and did not receive any assistance from PLANDERO in 1996 or 1997, the rate of stunting in first graders increased dramatically from just over 45 percent in 1994 to

Figure 6 Prevalence of stunting in two *municipios* of Western Honduras, 1994-97



nearly 75 percent in 1997. Although far from providing conclusive evidence of project impact, this example shows how it is possible to take advantage of existing data collection activities and extract potentially useful information about the evolution of nutritional status in the project zone of influence and in selected control areas. The analysis would have be strengthened if a finer level of geographical disaggregation could be achieved so that it were possible to examine the experience of communities with a high coverage of project activities; alternatively, PLANDERO could have undertaken its own data collection activities in selected sentinel sites and compared the experience of its own study population with that of the universe of first graders in the same *municipios*.

Evaluation

Table 8 compares the nutritional status of children from birth to 60 months of age in July/August 1997, and the same group (plus new births) seven to nine months later in March/April 1998. Results are shown separately for children living in PLANDERO 96 households and for those living in PLANDERO 97 households. The seven-to-nine-month interval between the two survey rounds encompassed the 1997-98 growing and harvest season,

Table 8 Mean anthropometric status by survey year and program status (PLANDERO 96 or PLANDERO 97), Western Honduras

		PLANDERO 96		PLANDERO 97	
Height-for-age	1997	-2.09 (*1.75*)	n=243	-2.12 (*1.69*)	n=215
	1998	-1.99 (*1.51*)	n=245	-2.18 (*1.53*)	n=250
	Change 1997-98	+0.10 (*0.15*)	P=0.51	-0.06 (*0.15*)	P=0.69
Weight-for-height	1997	-0.17 (*0.98*)	n=243	-0.17 (*1.17*)	n=217
	1998	-0.07 (*1.07*)	n=243	-0.04 (*0.97*)	n=249
	Change 1997-98	+0.10 (*0.09*)	P=0.27	+0.13 (*0.10*)	P=0.19
Weight-for-age	1997	-1.39 (*1.28*)	n=243	-1.42 (*1.32*)	n=214
	1998	-1.29 (*1.06*)	n=243	-1.35 (*1.13*)	n=250
	Change 1997-98	+0.11 (*0.11*)	P=0.31	+0.06 (*0.11*)	P=0.57

during which time both sets of households received technical assistance and credit from PLANDERO. The control community households could not be included in this analysis because they were not assessed prior to the final survey round.

The analysis shows that over this period, there was little change in anthropometric status either among PLANDERO 96 children or among PLANDERO 97 children, for any of the three indices examined. Furthermore, there was scarcely any evidence of differences between the experience of the two groups of children, although PLANDERO 96 children performed very slightly better than PLANDERO 97 children on the height-for-age indicator. In cases such as these, formal statistical hypothesis testing has little to add to the analysis.

One factor that should always be borne in mind when evaluating data in which the nutritional status of a given population or subpopulation is assessed on more than one occasion is the possibility of some change in the age structure of the population(s), which might invalidate uncontrolled comparisons. In the case of Western Honduras, the average age of the children surveyed in the PLANDERO 96 communities was very slightly different in July/August 1997 from that of the children in the PLANDERO 97 communities: 29.5 months versus 31.4 months, respectively. By March/April 1998, both study groups had aged somewhat, but this effect was more marked in the PLANDERO 97 communities so that the average ages of children surveyed at this time were 33.5 months and 36.7 months, respectively. Changes in average anthropometric indices, *adjusted statistically for changes in the age structure*, are shown in Table 9. This adjustment is sufficient to reverse the apparent direction of the evolution of height-for-age status in the PLANDERO 97 communities, so that their experience became comparable to the PLANDERO 96 communities. Thus, although technically demanding, age adjustment can be important to ensure the correct interpretation of results.

Table 9 Change in anthropometric status between July/August 1997 and March/April 1998, adjusted for changes in the age structure of the survey populations, Western Honduras

	PLANDERO 96		PLANDERO 97	
Height-for-age	+0.13 (*0.14*)	P=0.36	+0.06 (*0.15*)	P=0.67
Weight-for-height	+0.06 (*0.09*)	P=0.52	+0.09 (*0.10*)	P=0.37
Weight-for-age	+0.09 (*0.10*)	P=0.38	+0.09 (*0.11*)	P=0.41

Many of the children in this data set were measured both in 1997 and in 1998, making it possible to examine changes at the individual level. Table 10 shows that when this approach is taken, there appears to be a rather substantial (and very nearly statistically significant, at the 5 percent level) difference in weight gain between children living in PLANDERO 96 communities and those living in PLANDERO 97 communities, in favor of the former. However, this difference is attenuated when differences in the age composition of the two groups are taken into account as described above. The approach that focuses on individual change has the advantage of not confusing the impact of changes in individual status with the impact of modifications in the *composition* of the group studied. On the other hand, it is marred by the (possibly major) biases inherent in studying only those children present in both surveys. Evaluators therefore need to carefully weigh up the benefits and costs that would result from adopting this "cohort" approach.

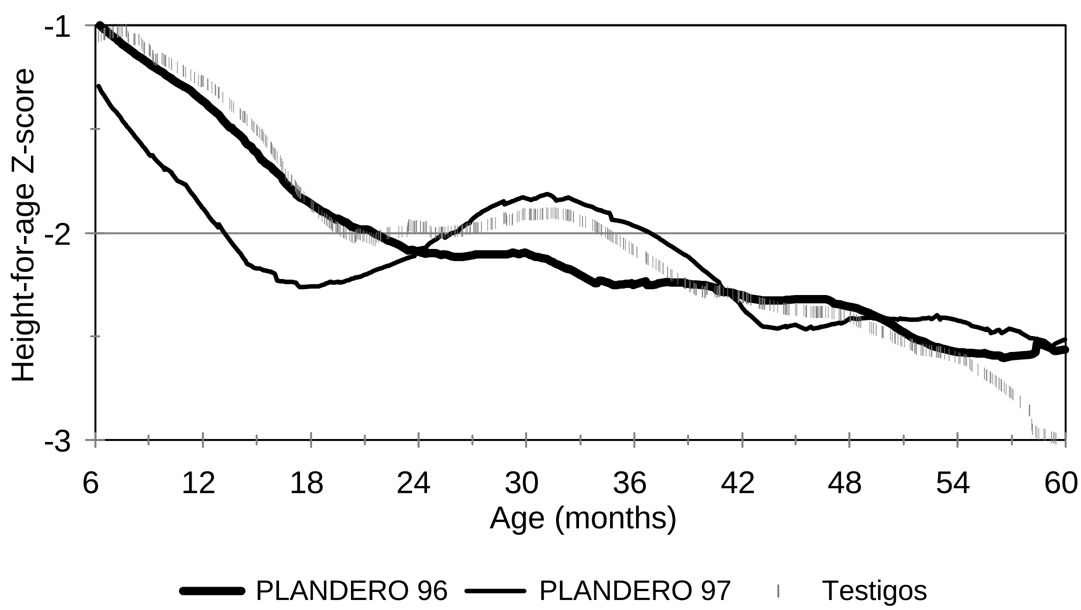
In the absence of data on the anthropometric status of children in the control communities in 1997, any inference about the impact of PLANDERO on nutritional status relative to areas not included in the program must be drawn entirely from the"post"-intervention observations of March/April 1998. In order to extract the maximum possible amount of information from these data, it is useful to graph average height-for-age Z-scores recorded at this time by program status

Table 10 Height and weight velocities of children living in the PLANDERO 96 and PLANDERO 97 study communities, Western Honduras, 1997-98

	PLANDERO 96	PLANDERO 97	
Height velocity (*cm per month*)	0.70 (*0.42*) n=179	0.67 (*0.36*) n=178	
unadjusted difference	0.03 (*0.04*)		P=0.46
age-adjusted difference	-0.01 (*0.03*)		P=0.82
Weight velocity (*g per month*)	193 (*119*) n=183	169 (*123*) n=183	
unadjusted difference	24 (*13*)		P=0.055
age-adjusted difference	15 (*11*)		P=0.17

(PLANDERO 96, PLANDERO 97, and controls). Such a graph is shown in Figure 7. Infants under six months of age were excluded because (1) they have been only briefly exposed to the project, and (2) most of their energy intake comes from breast milk, which is most unlikely to have been affected by the project activities. It can be seen that between 6 and 24 months of age, children from PLANDERO 97 communities were more stunted than PLANDERO 96 or control community children (who were similar to each other). From two years to 42 months, the PLANDERO 96 children were the ones to show most stunting. In this age group, the PLANDERO 97 and control community children had similar, higher height-for-age Z-scores. Above 48 months of age, the control community children were the most stunted. As stunting is basically established by two years of age in these communities, we can safely assume that the status of children four years and older represents the effects of variables that exerted their effect prior to the advent of PLANDERO in mid-1996. The experience of the younger children suggests a negative effect of PLANDERO's activities on stunting, but only in the year that each community first starts to receive technical assistance and credit from the program. It can be seen that this analytic strategy is convenient when there are no baseline data available, but results are prone to the vagaries of sampling variation and interpretation can be somewhat subjective.

Figure 7 Average height-for-age Z-scores in March/April 1998, by program status (PLANDERO 96, PLANDERO 97, and control communities)



NOTES

1. In order to allow for the normal variation in body size that is due to age and sex, observed measures are contrasted with the *expected* value for an individual of the same age and sex. For most commonly-used anthropometric measures, these expected values are taken to be the average (*median*) value in the U.S. population, as determined by the National Center for Health Statistics (NCHS). The NCHS database is referred to as the *reference population*. How far above or below the reference median a particular value lies is measured in multiples of the standard deviation in the reference population, with the resulting quantity being referred to as a *Z-score*. Thus, Z-scores are calculated as

$$Z = \frac{observed - \mu_{NCHS}}{\sigma_{NCHS}} ,$$

where μ_{NCHS} denotes the reference median, and σ_{NCHS} denotes the age-specific standard deviation in the reference population. There is currently much debate about the appropriateness of using the NCHS database to assess the growth of children and adolescents from different ethnic backgrounds, but it has generally been found that children from all countries and races can grow equally well up to 7 years of age (Habicht et al. 1974). At this age, height differentials within a race between children from different socioeconomic groups can reach 10 centimeters, while differences between races among children of high socioeconomic status do not exceed 1 centimeter.

2. The health profile of those attending health facilities is generally quite unrepresentative of the population as a whole, since people go to health facilities because they are sick. Similarly, those benefitting from selective programs are also unrepresentative, since such programs often target (or are self-targeted) towards the most needy. Alternatively, certain segments of the population may have characteristics that make it easy for them to access programs and services; such characteristics are likely to be associated with *better* health outcomes.

3. It is, of course, possible that the consumption of vegetables could displace other energy-rich items in adults' diets.

4. The intensive 'training effect' may itself alter the nutrition status of the population, particularly if it is accompanied by increased awareness of nutrition issues.

5. *Moving averages* are averages of community-level nutritional status over a number of different time points (often up to five or more). These averages are recalculated every time measurements are made, so that short-term variations are 'smoothed' by combining them with other measurements from different time-points. Medium-term trends are, however, reflected.

6. Why this should be the case may be understood by considering the case of an indicator such as height-for-age Z-score: at the initial survey, a child's height reflects the sum of all environmental influences (s)he has been exposed to since conception. On the other hand, his/her height at the final survey, will reflect the sum of all the environmental influences (s)he was exposed to from conception to project baseline, plus influences experienced during the course of project implementation. For the youngest children, the influences experienced during the implementation period will dominate the final measure; however, these children may have been

buffered against external influences by their mothers. The final height of older children, on the other hand, will be dominated by events that occurred before the beginning of the project, and therefore not particularly informative with respect to project impact.

7. See Report and Recommendation of the President to the Executive Board on a Proposed Loan to the Republic of Honduras for the Agricultural Development Programme for the Western Region (PLANDERO). International Fund for Agricultural Development 1993.

8. Labeled maps of the 18 *departamentos* of Honduras, and the 66 municipios of Western Honduras are included in Annex 1.

9. The scores assigned to each beneficiary household were equal to the rate of malnutrition in the *municipio* where the family resided. Thus, beneficiary families living in a *municipio* where 60 percent of all first graders were stunted were assigned a score of 60 each, while beneficiary families living in *municipios* where only 30 percent of first graders were stunted were assigned a score of just 30. The summary score for the whole project at any given point in time is calculated as the average of the scores assigned to each beneficiary household. The project may be described as neutral in its geographical targeting if the average score thus derived is the same as the prevalence of stunting in the area as a whole. If, on the other hand, the average score is higher than the prevalence of stunting in the region, then the project is targeting areas with more severe nutritional problems; similarly, if the score is lower than the prevalence of stunting, then the project is targeting areas with less severe problems. The process was repeated using rates of severe stunting (height-for-age Z-score <-3) instead of rates of total stunting (Z-score <-2).

ANNEX

Honduras

Western Honduras (Copán, Ocotepeque, and Lempira)

REFERENCES

Frankenberger, T., A. Peña-Montenegro, S. Tilakaratna, N. Velarde, and W. B. Eide. 1993. Rural poverty alleviation and nutrition: IFAD's evolving experiences. Staff Working Paper 14. International Fund for Agricultural Development, Rome.

Gibson, R. S. 1990. *Principles of nutritional assessment*. New York: Oxford University Press.

Habicht, J. P. 1974. Estandardización de métodos epidemiológicos sobre el terreno. *Boletín de la Oficina Sanitaria Panamericana* 76 (5): 375–384.

Habicht, J. P., R. Martorell, C. Yarbrough, R. M. Malina, and R. E. Klein. 1974. Height and weight standard for preschool children: How relevant are ethnic differences in growth potential? *Lancet* 1: 611–615.

Republic of Honduras, Secretary for Education. 1996. Sixth census of the height of first-grade school students, 1996. Tegucigalpa: Secretary for Education.

Republic of Honduras, Secretary for Health. 1996. National Micronutrient Survey 1996. Tegucigalpa: Secretary for Health.

Rogers, B. L., A. J. Swindale, and P. Ohri-Vachaspati P. 1996. Determinants of household food security in Honduras. A report on the National Household Consumption, Income, Expenditure and Nutrition Survey, 1993-1994. U.S. Agency for International Development, Washington, D.C.

UN ACC/SCN (United Nations Administrative Committee on Coordination/Sub-Committee on Nutrition). 1998. *Third report on the world nutrition situation*. Geneva.

WHO (World Health Organization), Expert Committee on Nutrition. 1995. Physical status: Uses and interpretation of anthropometry. Geneva.

WHO/UNICEF (World Health Organization/United Nations Children's Fund). 1994. *Indicators for assessing vitamin A deficiency and their application in monitoring and evaluating intervention programmes*. A report of a joint WHO/UNICEF consultation. Geneva: World Health Organization.